

The Stages of Change in three stage concepts and two modes of physical activity: a comparison of stage distributions and practical implications

Eva Martin-Diener^{1,2,3}, Nicole Thüning^{1,2}, Thomas Melges¹
and Brian W. Martin²

Abstract

Stages of Change were assessed for three stage definitions and two modes of health-enhancing physical activity (HEPA) in a representative telephone survey in Switzerland (participation 55.8%; $n = 1471$). Two five-stage definitions focusing either on intention to change or current behavior were integrated into a seven-stage concept, taking into account both aspects. The two target behaviors were activities with at least moderate intensity and activities with vigorous intensity. According to the two five-stage definitions, at least half of the participants were either in precontemplation (focus on intention) or in preparation (focus on behavior). Upon classification into the seven stages these large stage groups were differentiated. There were differences in the pros for change between the new stages of the seven-stage concept. One in seven participants was regularly active according to the moderate criteria, but not using the vigorous criteria, and one in every eight participants reported the inverse. Results show that an individual can be in different Stages of Change depending on the stage definition and be regularly active or not depending on the target behavior. The practical implications of the seven-stage algorithm and a two-dimensional matrix to classify participants for both moderate

and vigorous intensity activities in an Internet-based HEPA program are presented.

Introduction

The health benefits of physical activity and exercise are well documented (US Department of Health and Human Services, 1996). In Switzerland, first representative prevalence data (Martin *et al.*, 1999) revealed 37.3% of the population was active with vigorous intensity at least 3 times a week for at least 20 min according to the recommendations for training of cardiorespiratory fitness (American College of Sports Medicine, 1990) and 25.6% did not meet these criteria, but were regularly active in the sense of the basic recommendations for health-enhancing physical activity (HEPA) (Pate *et al.*, 1995; US Department of Health and Human Services, 1996), i.e. active with at least moderate intensity for at least half an hour on all or almost all days of the week. However, 37.1% of the Swiss population did not meet any of the two recommendations and had to be considered as not sufficiently active. Therefore, there is a need for intervention programs to promote physical activity in Switzerland. Recently, a motivational program to encourage participation in physical activity was developed (Martin-Diener and Thüning, 2001). This computerized program, *active-online.ch*, provides individually tailored counseling (Martin-Diener *et al.*, 1999; Kreuter *et al.*, 2000) and is based on the Transtheoretical Model of Behavior Change (Prochaska *et al.*, 1992) as a theoretical framework. This so-called 'expert system' (Velicer *et al.*, 1993) is implemented exclusively on the World Wide Web

¹Institute for Social and Preventive Medicine, University of Zürich, 8006 Zürich and ²Institute for Sport Science, Federal Office of Sports, 2532 Magglingen, Switzerland

³Correspondence to: E. Martin-Diener;
E-mail: eva.martin@baspo.admin.ch

and forms the heart of the website www.active-online.ch.

The Transtheoretical Model has been applied widely in health promotion and research. Its application to physical activity has been reviewed recently by others (Whitelaw *et al.*, 2000; Marshall and Biddle, 2001; Nigg and Riebe, 2002). The key elements of the Transtheoretical Model are the five distinct Stages of Change. The different Stages of Change cover behavioral, intentional and temporal aspects of health behavior change. In their original definition (DiClemente *et al.*, 1991) the first and the second stage are intentional stages (*precontemplation*: no intention to change; *contemplation*: consider change), the third stage is intentional and behavioral (*preparation*: intention to change in the near future, try new behavior), and the fourth and fifth stages are defined with behavioral and temporal criteria (*action*: new behavior for less than a defined time span; *maintenance*: new behavior for more than a defined time span). According to this definition and with the assumption of the target behavior being regular physical activity, contemplators, for example, will be individuals who are not yet regularly active, but consider becoming so.

In the Transtheoretical Model, the five Stages of Change are linked to three other constructs: decisional balance, self-efficacy and 10 processes of change. The decisional balance features, called pros and cons of behavior change, are assumed to vary systematically with the Stages of Change. This association has often been used as a measure for the construct validity of staging algorithms (Cardinal, 1997; Herrick *et al.*, 1997; Marcus and Owen, 1992; Marcus *et al.*, 1992a). Across different behaviors, the scores of the pros rise generally about 1 SD from precontemplation to the stage with the highest score (action or maintenance). This increase is largest between the precontemplation and the contemplation stage (Prochaska, 1994). The scores for the cons, on the other hand, decrease about 0.5 SD. In physical activity, the increase of the pros has been found to be up to 2 SD, due to a large increase from the precontemplation to the contemplation stage (Reed *et al.*, 1997).

The Stages of Change were first defined for smoking cessation and then applied to other health

behaviors (Prochaska *et al.*, 1994). The transfer of the stage concept to research and practical applications in the promotion of physical activity resulted in a variety of stage definitions, that differ regarding (1) the *stage concepts*, (2) the definition of the *desired behavior* and (3) the *assessment format* (Reed *et al.*, 1997; Nigg and Riebe, 2002). As in any other HEPA project applying the Stages of Change, in our Internet project *active-online.ch* choices also had to be made regarding the stage concept, the desired behavior with the corresponding target criteria and assessment formats.

The following two stage concepts are used most often. (1) The concept derived from the original smoking cessation algorithm (DiClemente *et al.*, 1991) which in the first three stages focuses mainly on the *intention to change*. (2) The concept focusing on *current behavior* introduced by Marcus *et al.* (Marcus *et al.*, 1992b). When stage distributions are defined according to these concepts, in both cases one large and heterogeneous group results. With the concept focusing on intention to change, it is the precontemplation stage, because the only criterion to be classified into this stage is to have no intention to become regularly active, independent of the current level of activity. In HEPA promotion, such a dichotomous view of the behavior—active enough versus not active enough—is questionable, both from the motivational and the physiological point of view. The process of adopting regular activity rather involves two major behavioral steps: from inactivity to occasional activity to regular activity. The concept focusing on current behavior reflects these two steps. However, according to this definition, the preparation stage becomes very heterogeneous, because the intentional dimension is completely omitted. Additionally, the motivational aspect of behavior change is lost to a considerable extent, which is in contradiction of the theory.

Thus, with both concepts one of the key variables of the Stages of Change for physical activity—either current behavior among those not regularly active or intention to become regularly active—is not assessed. In a computerized tailored intervention program no human counselor can gather this missing information. Therefore, there was a need to develop a stage concept for the program *active-online.ch* to

allow the assessment of both the intentional and behavioral dimension.

In most current applications of the Stages of Change model, the desired behavior is vigorous intensity activity and the target criteria correspond to the recommendations for the training of cardiorespiratory fitness. In other applications, moderate intensity activity has been used, using intensity, duration and frequency of activity as criteria (Reed *et al.*, 1997), but also other concepts of defining the behavior of interest (Mäkelä *et al.*, 2000; Marttila and Nupponen, 2002). In Switzerland, there is a consensus to use the current recommendations for activities with at least moderate intensity in HEPA projects as target behavior. However, a representative population survey in Switzerland revealed (Martin *et al.*, 1999) that 12.6% of the Swiss population seemed to meet the criteria for vigorous activities, but not for activities with at least moderate intensity. These individuals would be misclassified as not active enough if only the moderate criteria were used. On the other hand, 25.6% met the criteria for at least moderate, but not vigorous activities, and would be misclassified if only the vigorous criteria were used.

The first objective of this study was to develop a stage concept to integrate both the intentional and behavioral dimension into a single staging algorithm. The second objective was to assess prevalence of physical activity, stage distributions and some aspects of construct validity for activities with at least moderate and activities with vigorous intensity, using the two commonly used five-stage concepts as well as the integrated seven-stage concept taking into account both intention and behavior. The practical implications of the choice of a stage concept will be discussed, and a two-dimensional approach to use both the criteria for activities with moderate and vigorous intensity to classify participants in a HEPA project will be presented.

Methods

Sampling procedure

A computer-assisted telephone interview was conducted in Switzerland using a random-random

procedure. Eligible subjects had to be at least 20 years old. In a first step, 3581 valid addresses of private households were randomly selected from the telephone directory. Disproportional samples for the three language regions were drawn to obtain an acceptable precision for prevalence estimations also in the French and the Italian speaking part of the country (20.5 and 4.1% of the population, respectively): 1805 addresses for the German, 889 for the French and 887 for the Italian language region of the country were drawn. In the contacted households, an eligible target person was selected randomly in a second step.

The decisional balance scale was administered to all participants who were not sufficiently active, to every subject in the action stage, to every fourth individual in the maintenance stage in the German interview, and to every second individual in the maintenance stage in the French and Italian interview. This restriction was used to optimize the stage distribution for the analyses—as a large proportion of the participants was expected to be in the maintenance stage and as no representative data was necessary to test the validity of the stage concepts.

The interviews took place from 24 March until 4 May 2000 by a demographic study institute. Every identified household received an announcement letter explaining the target of the survey a few days before the first call of an interviewer. The mean duration of the interview was 21.7 min.

Questionnaire

A telephone questionnaire was developed and pre-tested in German, and then translated into French and Italian. It included questions on socio-demographic characteristics, lifestyle, behavior and attitudes regarding physical activity. In each item on physical activity, a short descriptive definition of the behavior in question was given before any question was asked to the participant.

Measurements

We assessed the Stages of Change for both activities with at least moderate and vigorous intensity, respectively. The telephone algorithm (see Appendix) for each behavior was developed in order to be able to

classify participants according to the two established five-stage concepts and our combined seven-stage concept (Figure 1). Activities with at least moderate intensity were considered to meet the recommendations if they were performed for at least half an hour on all or almost all days of the week. These two criteria were asked in two steps. After a general description of the behavior, participants were asked whether they engaged in such activities on all or almost all days of the week. Only those who answered *yes* were asked about the second criterion, whether they did these activities for at least half an hour a day. The metabolic term ‘moderate intensity activities’ was described as ‘activities that cause you to get slightly out of breath’ and typical examples of activities were given. The target criteria for activities with vigorous intensity were at least 3 times a week for at least 20 min each time. The metabolic term ‘vigorous activities’ was described as ‘activities that cause you to break a sweat’ and activity examples were given as well. All questions are given in detail in the Appendix.

As a decisional balance measure, the scale developed in German by Basler *et al.* (Basler *et al.*, 1999) for vigorous intensity activities was used

(Cronbach’s α for the pros scale: $\alpha = 0.87$; for the cons scale: $\alpha = 0.76$). The wording was adapted to also include moderate intensity activities mainly by replacing expressions like ‘sports’ or ‘exercise’ by ‘physical activity’. The items of the pros scale were about experiencing well-being and less stress, having more energy, and remaining fit. The items of the cons scale were about issues of time consumption and organization, and overcoming one’s barriers.

Data analysis

To account for the disproportional sample sizes in the language regions, the random–random procedure and potentially differential participation rates, prevalence data were weighted for language region, gender, age and household size. Statistical analyses were performed with the software package Stata (version 7.0).

Results

Participation and sample characteristics

A total number of 1620 interviews was realized (55.8% of all addresses where a contact had been

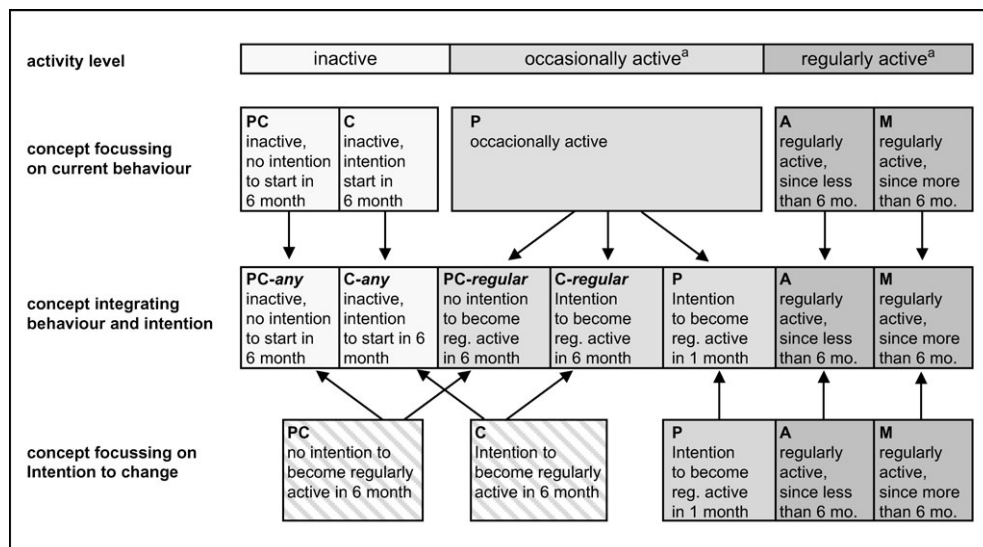


Fig. 1. Three concepts of the Stages of Change for physical activity. PC = precontemplation, C = contemplation, P = preparation, A = action, m = maintenance; -any: intention/no intention for any activity, -regular: intention/no intention for regular activity.

^aRegular physical activity defined according to behavior and target criteria under consideration.

established; 45.1% of the total original random sample), 800 in the German, 408 in the French and 412 in the Italian language region; 40.7% of the interviews were lost on the household level (13.5% no contact established, 7.6% not able to participate because of health or language problems, 19.6% refused to participate); 14.2% were lost on the individual level (5.4% no contact established, 3.0% not able to participate because of health or language problems, 5.8% refused to participate). Seventy individuals were excluded from the analysis because they were not able to walk 200 m without pain or support. Another 79 subjects could not be classified according to one or more stage definitions under consideration because of missing data and were also excluded from analysis. The final sample thus comprised 1471 subjects. The subsample with data on the pros comprised 1023 subjects—55.3% were females and mean age was 48.2 years (SD 16.7 years); 38.3% of the participants had a higher education, 48.7% a vocational education and 13.0% no further education after mandatory school.

Prevalence of physical activity and Stage of Change distributions

According to the moderate intensity criteria, 22.1% [95% confidence interval (CI) 19.5–24.8%] were inactive, 50.0% (95% CI 46.8–53.4%) were occasionally active and 27.9% (95% CI 25.1–30.8%) regularly active. The respective numbers for vigorous intensity activities were 50.4% (95% CI 47.1–53.6%), 24.4% (95% CI 21.6–27.3%) and 25.2% (95% CI 22.4–28.4%). For both target behaviors less than one-fifth of the individuals occasionally active declared having an intention to become regularly active. The details of the stage distributions according to Figure 1 can be seen in Table I.

Two-dimensional distribution of both target behaviors

Of the respondents, 15.2% (95% CI 13.1–17.5%) reported to be regularly active according to the moderate intensity criteria, but not to the vigorous intensity criteria; 12.5% (95% CI 10.3–15.2%) reported the inverse. The detailed two-dimensional seven-stage distribution is shown in Table II.

Association between stages of change and the pros for change

The pros for change for the classification according to all three stage concepts and the two behaviors are given as standardized *T* scores (mean = 50 and SD = 10) in Table III. An analysis of variance with a *post hoc* Scheffé test was significant for all three stage concepts (activities with moderate intensity: concept focusing on behavior: $P < 0.001$; $F = 23.76$, d.f. = 4; concept focusing on intention: $P < 0.001$; $F = 27.2$, d.f. = 4; concept focusing on behavior and intention: $P < 0.001$; $F = 20.08$, d.f. = 6. Activities with vigorous intensity: concept focusing on behavior: $P < 0.001$; $F = 21.00$, d.f. = 4; concept focusing on intention: $P < 0.001$; $F = 15.29$, d.f. = 4; concept focusing on behavior and intention: $P < 0.001$; $F = 15.9$, d.f. = 6).

When participants were classified for *activities with at least moderate intensity*, the largest increase for the pros of change between two adjacent stages could be observed from the precontemplation to the contemplation stage for the concept focusing on behavior ($P < 0.001$), and between precontemplation-*any activity* and contemplation-*any activity* in the combined model, respectively ($P < 0.001$). Other important, although not statistically significant increases, could be seen from the contemplation to the preparation stage for the concept focusing on intention ($P = 0.147$), from contemplation-*regular activity* to preparation ($P = 0.290$), and between precontemplation-*any activity* and precontemplation-*regular activity* ($P = 0.342$).

When participants were classified for *activities of vigorous intensity*, the same statistically significant increase could be observed from the precontemplation to the contemplation stage according to the model focusing on behavior ($P < 0.001$). In comparison to the classification for activities with at least moderate intensity, the increase between the two precontemplation groups (*any activity* to *regular activity*) was even more pronounced and statistically significant ($P = 0.001$).

Association between stages of change and the cons for change

For the stage concept focusing on behavior as well as for the concept focusing on intention, and for both

Table I. Stage distributions for three concepts of the Stages of Change and two physical activity behaviors; percentages weighted for language region, household size, gender and age (n = 1471)

Stage of Change	Concept for stage definition: focus on...			Stage of Change
	Current behavior [prevalence (%)]	Intention to change [prevalence (%)]	Behavior and intention [prevalence (%)]	
Behavior: activities with at least moderate intensity ^a				
precontemplation	17.8	62.1	17.8	precontemplation- <i>any</i>
contemplation	4.3	5.0	4.3	contemplation- <i>any</i>
			41.7	precontemplation- <i>regular</i>
			3.3	contemplation- <i>regular</i>
preparation	50.0	5.0	5.0	preparation
action	0.9	0.9	0.9	action
maintenance	27.0	27.0	27.0	maintenance
Behavior: activities with vigorous intensity ^b				
precontemplation	40.9	68.9	40.9	precontemplation- <i>any</i>
contemplation	9.5	3.0	9.5	contemplation- <i>any</i>
			20.2	precontemplation- <i>regular</i>
			1.3	contemplation- <i>regular</i>
preparation	24.4	2.9	2.9	preparation
action	2.4	2.4	2.4	action
maintenance	22.8	22.8	22.8	maintenance

-any: intention/no intention for any activity, -regular: intention/no intention for regular activity (see Figure 1).

^aTarget criterion: activities that cause to get at least slightly out of breath for at least half an hour a day on all or almost all days of the week.

^bTarget criterion: activities that cause sweating at least 3 times a week for at least 20 min each time.

Table II. Two-dimensional stage distribution for two physical activity behaviors; percentages weighted for language region, household size, gender and age (n = 1471)

Activities with vigorous intensity ^b : Stage of Change (%)	Activities with at least moderate intensity ^a : Stage of Change (%)							
	PC-any	C-any	PC-reg	C-reg	P	A	M	Total
PC-any	13.25	0.82	15.32	1.02	1.61	0.22	8.62	40.86
C-any	0.88	2.28	2.54	0.48	1.15	–	2.20	9.52
PC-reg	2.07	0.22	13.33	0.70	0.59	0.12	3.17	20.20
C-reg	0	0	0.61	0.21	0.13	–	0.24	1.27
P	0.17	0	1.60	0.12	0.38	0	0.49	2.88
A	–	–	0.51	0.23	0.37	0.40	0.91	2.43
M	1.38	0.86	7.83	0.55	0.80	0	11.34	22.84
Total	17.75	4.28	41.74	3.31	5.03	0.91	27.00	100

PC = precontemplation, C = contemplation, P = preparation, A = action, M = maintenance; -any: intention/no intention for any activity, -reg: intention/no intention for regular activity (see Figure 1).

^aTarget criterion: activities that cause to get at least slightly out of breath for at least half an hour a day on all or almost all days of the week.

^bTarget criterion: activities that cause sweating at least 3 times a week for at least 20 min each time.

Table III. Standardized T scores for the pros for change for three concepts of stage definitions and two physical activity behaviors (n = 1023)

Stage of Change	Concept for stage definition: focus on...			Stage of Change
	Current behavior [<i>T</i> score (SD)] ^a	Intention to change [<i>T</i> score (SD)] ^a	Behavior and intention [<i>T</i> score (SD)] ^a	
Behavior: activities with at least moderate intensity ^b				
precontemplation	47.0 (10.4)	48.3 (10.0)	47.0 (10.4)	precontemplation- <i>any</i>
contemplation	52.2 (8.8)	51.7 (9.6)	52.2 (8.8)	contemplation- <i>any</i>
			48.9 (9.9)	precontemplation- <i>reg</i>
			49.4 (9.7)	contemplation- <i>reg</i>
preparation	49.7 (9.9)	54.8 (8.3)	54.8 (8.3)	preparation
action	51.9 (7.5)	51.9 (7.5)	51.9 (7.5)	action
maintenance	57.8 (7.0)	57.8 (7.0)	57.8 (7.0)	maintenance
differences with <i>P</i> < 0.05 according to Scheffé multiple comparison test	PC < C, P, M; C < M; P < M	PC < P, M; C < M	PC- <i>any</i> < C- <i>any</i> , P, M; C- <i>any</i> < M; PC- <i>reg</i> < P, M; C- <i>reg</i> < P, M	differences with <i>P</i> < 0.05 according to Scheffé multiple comparison test
Behavior: activities with vigorous intensity ^c				
precontemplation	47.3 (10.4)	48.8 (10.1)	47.3 (10.4)	precontemplation- <i>any</i>
contemplation	52.1 (8.7)	53.5 (8.2)	52.1 (8.7)	contemplation- <i>any</i>
			51.0 (9.3)	precontemplation- <i>reg</i>
			53.0 (7.9)	contemplation- <i>reg</i>
preparation	51.9 (9.1)	56.8 (7.3)	56.8 (7.4)	preparation
action	52.6 (12.4)	52.6 (12.4)	52.6 (12.4)	action
maintenance	55.1 (8.7)	55.1 (8.7)	55.1 (8.7)	maintenance
differences with <i>P</i> < 0.05 according to Scheffé multiple comparison test	PC < C, P, M	PC < P, M	PC- <i>any</i> < C- <i>any</i> , PC- <i>reg</i> , P, M	differences with <i>P</i> < 0.05 according to Scheffé multiple comparison test

PC = precontemplation, C = contemplation, P = preparation, A = action, M = maintenance; -*any*: intention/no intention for any activity, -*regular*: intention/no intention for regular activity (see Figure 1).

^aStandardized T scores with mean = 50 and SD = 10.

^bTarget criterion: activities that cause to get at least slightly out of breath for at least half an hour a day on all or almost all days of the week.

^cTarget criterion: activities that cause sweating at least 3 times a week for at least 20 min each time.

target behaviors, cons were lower in the precontemplation than in the contemplation stage and lowest in maintenance compared to all other stages. For the seven-stage concept integrating behavior and intention, the cons in the two precontemplation stages were lower than in the three stages with intention to change. Overall differences in the cons were—as expected—smaller than in the pros (about 0.7 versus about 1.0 SD; detailed data not shown).

Discussion

The Transtheoretical Model, originally developed for smoking cessation and then transferred to other

health behaviors, is widely used in physical activity promotion. The two most commonly used five-stage concepts focus either on intention to change or on current behavior. We integrated both the intentional and behavioral dimension into a seven-stage concept. Prevalence data on physical activity behavior and stage distributions as well as some aspects of construct validity were evaluated in a representative population survey for activities with at least moderate intensity and activities with vigorous intensity.

Stage distributions and construct validity

Prevalence of physical activity and the stage distributions varied considerably, depending on the stage

definition and the target behavior. According to the five-stage definition focusing on intention to change, two-thirds of the participants were in the precontemplation stage, both for activities with at least moderate and activities with vigorous intensity. The seven-stage algorithm differentiated within these precontemplation groups. Regarding moderate intensity activities, one out of three individuals was completely inactive and two-thirds were somewhat active, but not regularly. For vigorous intensity activities, two individuals out of three were completely inactive. Using the five-stage algorithm focusing on current behavior, on the other hand, half of the participants were in the preparation stage for at least moderate intensity activities and one-quarter was in the preparation stage for activities with vigorous intensity. The seven-stage algorithm revealed that both for activities with at least moderate and vigorous intensity only 10% of those in these preparation groups were truly preparing, thus having the intention to become regularly active within 1 month. The association between the Stages of Change and the pros for change served as a measure for the construct validity of the different stage algorithms. The increase of about 1 SD from the stage with the lowest pros score to the stage with the highest score corresponded to the expected general pattern (Prochaska 1994). However, the large precontemplation and preparation groups, respectively, of the two five-stage models were shown to be heterogeneous regarding the pros for change: within the preparation group of the model focusing on current behavior, the 'true' preparers had higher pros than those who had no intention to change. The precontemplation group of the model focusing on intention was heterogeneous as well. When classified for vigorous intensity activities, those who were completely inactive had lower pros than those who were active occasionally. For activities with moderate intensity the same tendency was observed. Overall, when interpreting the associations between stages of change and pros scores cautiously, it seems that intention to change should be the leading principle for stage classification and not current behavior.

These findings have immediate practical implications for HEPA interventions using stage-matched materials. With the five-stage concepts, more than

half of all individuals not active regularly will be addressed either as precontemplators or as preparers, and therefore get different materials, feedback and strategies—just depending on the measurement concept used. The application of five-stage algorithms has consequences in individually tailored interventions using normative comparisons as well. With the stage concept focusing on intention, for example, a completely inactive individual will also be compared to those who are already somewhat active, regarding his or her pros for change. This might result in inappropriate feedback, because the stage-specific norm for the pros for change has been set too high. The seven-stage algorithm differentiates within these heterogeneous precontemplation and preparation groups, respectively, because it takes into account both intention and current behavior among those not active on a regular basis.

In practice, the choice of the most appropriate stage concept for an intervention to adopt and maintain physical activity will depend on the characteristics of the target group, the target behavior and the method of the intervention. With a very sedentary population, for example, the concept focusing on behavior might be most appropriate because participants have a chance to progress two stages, even if they do not yet meet or intend to meet the target criteria. In an intervention where the main target is the promotion of regular activity, the concept focusing on intention is probably more appropriate. Using the seven-stage algorithm in an intervention with a population which is heterogeneous both regarding behavior and intention, a finer stage classification and a more differentiated monitoring of stage progression is possible.

Two target behaviors

Not only the stage definition, but also the target behavior seems to be crucial for the prevalence of physical activity and stage classification. Among those regularly active, about one-third met the current HEPA recommendation, but not the recommendations for the training of cardiorespiratory fitness, about one-third reported the inverse situation and one-third met both criteria. Among all those ready to change (in preparation according to the seven-stage

model), about two-thirds seemed to be motivated more for moderate intensity type of activities and one-third seemed to prefer vigorous activities. Thus, people have different preferences regarding their type of behavior and some people seem to be ready for one behavior, but not for the other.

A practical application

Based on the findings outlined above, as well as theoretical and practical considerations, a two-dimensional stage classification matrix (Figure 2) was used in the computerized tailored intervention system for HEPA promotion, *active-online.ch* (Martin-Diener and Thüring, 2001). In such an intervention program, no human counselor has the opportunity to ask for missing information on intention to change, current behavior or preferred type of activity. Therefore, all relevant information has to be gathered using a programmed algorithm.

When the seven-stage concept focusing on intention and behavior is used for two different behaviors, a matrix with 49 cells results (Table II). Because it was found that some of the cells were empty or prevalence in some cells was very low and particularly for reasons of practicability, the 49 cells were collapsed to 15 groups to classify participants and provide stage-matched feedback. These 15

groups differ regarding current behavior, intention to change and preferred type of activity. All those who are completely inactive or irregularly active with no intention to change are motivated for moderate intensity activities (Groups 1–3 and 6). Those who intend to become regularly active or who are in the action stage are motivated for the behavior that they prefer (Groups 4, 5, 7, 11, 12 and 14). Those who are in the maintenance stage for moderate intensity activities and have no intention to start with or to do more vigorous activities are congratulated for their current behavior, and then given the option to think about strength and flexibility training (Groups 8 and 9). Those who are in the maintenance stage for moderate intensity activities and intend to start with or to do more vigorous activities are motivated to do so (Groups 10 and 13). Those who are in the maintenance stage for vigorous activities finally are also given the opportunity to think about strength and flexibility training (Group 15). This matrix has proven useful as a basis to tailor feedback, but was at the upper limit regarding complexity and practicability.

Limitations of self-report

Prevalence of regular physical activity in this study was remarkably lower than in other samples of

		Activities with at least moderate intensity						
		PC-any	C-any	PC-reg	C-reg	P	A	M
Activities with vigorous intensity	PC-any	1 ↑	↑	↑	↑	↑	↑	8 ↘
	C-any		2	3	4	5	7	10 ←
	PC-reg			6 ↑				9 ↘
	C-reg				11 ←			13 ←
	P					12 ←		
	A						14 ←	
	M							15 ↘

Fig. 2. Stage categorization of participants in a computerized counseling system for two physical activity behaviors. PC = precontemplation, C = contemplation, P = preparation, A = action, M = maintenance; -any: intention/no intention for *any* activity, -reg = intention/no intention for *regular* activity; h: participants motivated towards moderate intensity activities (Groups 1–7); f: participants motivated towards vigorous intensity activities (Groups 10–14); m: participants motivated to think about strength and flexibility training (Groups 8, 9 and 15).

nationally representative data (Martin *et al.*, 1999). One explanation for the differences could be the participation in this survey, which was only moderately good. Males (44.7%) were slightly under-represented compared to the general population (48.7%) and the group over the age of 55 was over-represented by about 8%. This is an indication that some selection, also regarding other variables, may have occurred. However, such effects on physical activity prevalence can be expected to be rather small because the weighting procedure in the analyses accounts for differences to the general population regarding age, gender and household size distributions. We suppose that this difference in physical activity prevalence is rather attributable to different operationalizations of the target criteria for regular activity in the two studies. In our study, the HEPA criteria for regular activity were asked in two questions (first frequency, then duration), whereas in the other study both criteria were asked in the same standard question. It seems that particularly the criterion 'daily or almost daily' is interpreted rather liberally when it is asked in the same question with the duration criterion. Which of the two operationalizations is more appropriate to assess true levels of activities with at least moderate intensity should be subject to further investigations.

A limitation of the description of the HEPA target behavior 'activities with at least moderate intensity' became obvious in this study. Theoretically, the term 'activities with *at least* moderate intensity' should also include vigorous intensity activities. Therefore, it should not be possible to be classified as active with vigorous intensity, but completely inactive with at least moderate intensity. However, for 9.5% of those who were active vigorously, this was the case. Both limitations of self-reported physical activity outlined above undermine the need for further research regarding validated instruments for self-report as well as objective measures to assess physical activity levels.

Conclusions

- The study results demonstrate that prevalence of physical activity and stage of change distribu-

tions vary considerably with the stage concept and the target behavior under consideration. Results revealed that individuals prefer different types of physical activities, both regarding their current and intended behavior.

- When the five stage concepts are used, either current behavior or intention to become regularly active is not assessed among those not active on a regular basis. When the five stage concepts are applied in stage-matched interventions, more than half of these inactive individuals are addressed and counseled either as precontemplators choosing one or as preparers choosing the other stage concept.
- The suggested seven-stage concept integrating intention and behavior allows a finer stratification of inactive individuals. There are meaningful differences in the pros for change between the newly formed stages. The two-dimensional seven-stage classification allows individual feedback for two target behaviors by using a programmed algorithm.
- In intervention projects stage concepts should be chosen depending on the target group, the target behavior as well as the method of the intervention.

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Appendix: Staging algorithm and questions for the three stage concepts in the telephone administration mode (Figure A1)

Free translation of German questions

Activities with at least moderate intensity

Q1 We are talking about physical activities now that cause you to get at least slightly out of

breath. Examples are brisk walking, hiking, dancing, gardening or many sporting activities. Do you currently engage in physical activities that cause you to get slightly out of breath?

Q2 Do you intend to start with physical activities that cause you to get at least slightly out of breath within the next 6 months?

Q3 Do you intend to engage in such activities regularly, meaning daily or almost daily?

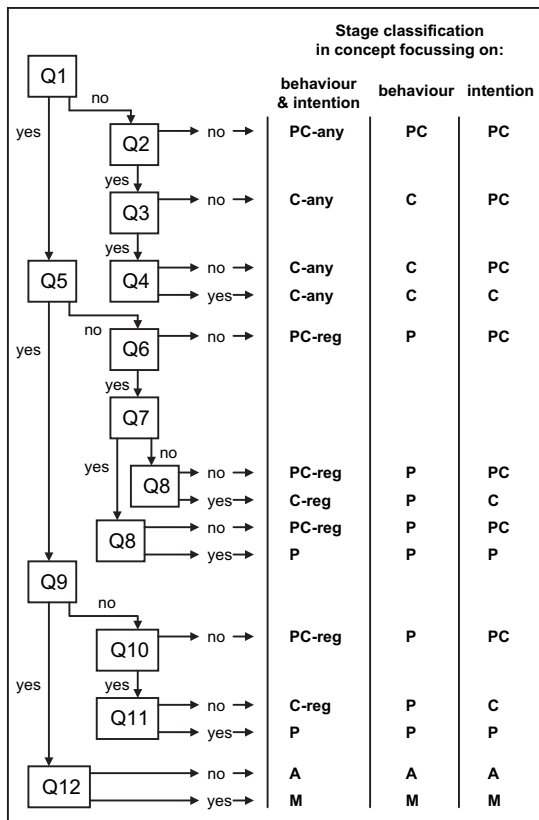


Fig. A1. Algorithm and stage classification for three stage concepts. PC = precontemplation, C = contemplation, P = preparation, A = action, M = maintenance; *-any*: intention/no intention for *any* activity, *-reg* = intention/no intention for *regular* activity.

Q4 Do you intend to engage in such activities daily or almost daily for at least half an hour?

Q5 Do you engage in such activities regularly, meaning daily or almost daily?

Q6 Do you intend to become active daily or almost daily within the next 6 months?

Q7 Do you plan to start with daily or almost daily activities within 1 month?

Q8 Do you intend to become active daily or almost daily for at least half an hour each time?

Q9 Do you engage in such daily or almost daily physical activities that cause you to get slightly out of breath for at least half an hour each time? [Interviewer: Increments of at least 10 min can be added up throughout the day]

Q10 Do you intend to become active daily or almost daily for at least half an hour within the next 6 months?

Q11 Do you plan to start within 1 month?

Q12 Have you been regularly active for at least half an hour daily or almost daily since more than 6 months?

Activities with vigorous intensity

Q1 Now we are talking about physical activities or training activities that cause you to break a sweat. Examples are jogging, aerobics or cycling fast. Do you currently engage in physical activities or training activities that cause you to break a sweat?

Q2–Q12 Analogous to questions for activities with moderate intensity, with a frequency of at least 3 times per week and a duration of at least 20 min as target criteria.